J. HYM. RES.
Vol. 14(2), 2005, pp. 177–181

Notes on Host Searching by the Parasitic Wasp *Zaglyptogastra* Ashmead (Hymenoptera: Braconidae: Braconinae) in Kibale Forest, Uganda

Donald L. J. Quicke and Nina M. Laurenne

(DLJQ) Division of Biology, Imperial College London, Silwood Park Campus, Ascot, Berkshire, SL5 7PY, UK and Department of Entomology, The Natural History Museum, London SW7 5BD, UK; (NML) Finnish Museum of Natural History, Zoological Museum, Entomological Division, P.O. Box 17 (P. Rautatiekatu 13), FIN-00014 University of Helsinki, Finland.

Abstract.—Females of more than one species of the braconine wasp genus *Zaglyptogastra* were observed, on multiple occasions, probing with their highly mobile ovipositors into dead wood through the exit holes made by various beetles (Scolytidae and others) which were themselves far too small to be hosts of the wasp. Given that the structure of the ovipositor in this genus precludes drilling, it is proposed that the intersections of burrows of smaller beetles with those of the actual host provides one possible route by which hosts can be located. Our failure to find any parasitized hosts in the substrate the wasps were probing suggests that their mode of host location is not very reliable.

Host records are not available for about half of the parasitic wasp genera known from the Afrotropical Region, and for far fewer if we consider only those genera that are endemic to the continent. Even when records are present in the literature, there are potential problems. Misidentifications of either host or parasitoid or both are not infrequent, and for parasitoids of concealed hosts in particular there is the problem of mis-association (Noyes 1994, Shaw 1994, 2003). The next issue is that even if a good host record exists for a genus, the likelihood is that for most genera there is only one host record, so generalising is a risky business. Here we report on species of the braconid genus *Zaglyptogastra* Ashmead which suggests that the host associations of the genus may be more complicated than previously thought.

Zaglyptogastra is a genus of large wasps (up to 2cm body length) that are restricted to the Palaeotropics. It is also one of several genera and species of Braconinae that have remarkably modified ovipositors that appear to be adaptations to either penetrating under the edge of a host retreat or steering the wasp's ovipositor tip within the host's retreat (Quicke 1991b, Quicke et al. 1995). *Zaglyptogastra* has the apical third or so of the ovipositor formed into a series of (typically three) arch-like regions in common with, though more developed than in *Undabracon* Quicke, *Serrundabracon* van Achterberg and several tersilochine and cremastine ichneumonids. The mechanics of the ovipositor of at least some *Zaglyptogastra* species were worked out by Quicke (1991b) who showed that, by pushing the lower ovipositor valves posteriorly relative to the upper valves, the whole tip of the ovipositor can be bent ventrally through more than 180°. This gives *Zaglyptogastra* females the ability not only to access hosts more easily but also to sting—though the effect isn't very painful (pers. obs.). However, a consequence of this ovipositor modification, in which the apex of the up-

per valve is typically blunt and broadly rounded, is that the female wasps cannot 'drill' through solid substrate to reach their hosts, or even thread their ovipositors through the narrow cracks and fissures that many parasitic wasps probably do (Gauld 1991). There are no absolutely definite host records for *Zaglyptogastra* species, though there is compelling evidence that one species is a parasitoid of larvae of the cerambycid beetle, *Dirphya princeps* Jordan, (Crowe 1962 [as *Iphiaulax* sp.], El-Heneidy and Quicke 1991), a minor pest of coffee in East Africa. *Dirphya princeps* bores coffee twigs and makes frass holes at intervals along the twigs, and it was supposed that it was through these frass holes that the *Zaglyptogastra* gained access to its presumed host.

OBSERVATIONS

Observations were made in both August 2003 and August 2004 near Makerere University Biological Field Station, Kanyawara, Kibale National Park, West Uganda, in an area of montane rain forest that was lightly logged in 1960 (Area 14 in Struhsaker 1997). Multiple females of what appeared to be a single *Zaglyptogastra* species were observed ovipositor probing into each of two dead trees in Kibale in 2003, and multiple females of at least two species were observed (and filmed) ovipositor probing on a dead, up-rooted tree in Kibale in 2004.

At the first of the 2003 observation sites, in the forest near a tree fall gap, up to 4 females were seen sitting on, or probing into, an approximately 2m high dead small tree trunk approximately 10cm in diameter (site A). Most were concentrating their attention on a small region of trunk approximately 1.3 m above the ground, though one or two individuals were occasionally observed investigating near the base of the dead tree.

At a second 2003 site (site B), up to three females were observed probing a small, dead, felled tree by the side of a forestry road. On both occasions, the wasps were seen probing their ovipositors into small round beetle emergence holes (Fig. 1), which at the second site, appeared to belong to scolytids that had developed within the wood (presence of scolytids was verified by dissection and discovery of characteristic sub-cortical galleries). At the second site we started to saw the branch that the wasps had been probing with their ovipositors for future dissection, and during one pause, a female *Zaglyptogastra* alighted on the log and started probing her ovipositor into the saw cut.

In 2004, up to 4 females, clearly representing two species (based on size and coloration; see Quicke 1991a) were observed, over a period of several days, searching and ovipositor probing into small beetle emergence holes in a horozontal trunk (c. 15cm diameter) approximately 2 m off the ground of a *Trilepisium madagascariense* D.C. (= *Bosqueia phoberos* Baill.) (Moraceae) tree which had been up-rooted due to the fall of an adjacent *Celtis africana* Burm. f. (Celtidaceae) tree strangled by *Ficus brachylepis* Welw. Ex Hiern (Moraceae). The *Trilepisium* had many black, charcoal-like, more or less round and slightly raised fungal patches the centres of many of which had one or more small circular, beetle emergence holes, and it was primarily in these that the *Zaglyptogastra* females probed their ovipositors.

All these wood substrates were removed for dissection at a more convenient locality. The first (i.e. the small, standing, dead tree) and the *Trilepisium* yielded not a single suitable potential host at the site of interest at about 1m above the ground, though one large beetle larva was found near the base. For the road-side tree, dissection revealed several suitably sized but active (i.e. unparalysed and therefore presumably unparasitised) beetle larvae immediately below the bark and a few apparently conspecific ones that had bored deeper into the substrate presumably to make pupation chambers.

Fig 1. *Zaglyptogastra* 'hot spot' showing many scolytid beetle emergence holes and field saw for scale.

At the road-side tree and on the *Trilepisium*, it was possible to observe how *Zaglyptogastra* females used their antennae during host searching. While antennae of set and of living females normally show no special features (Fig. 2A; arrow), those of host-locating females are sharply angled ventrally close to their tips, especially in lateral view (Fig. 2B-E), and it seems likely that this is an adaptation to penetrating the openings of potential intermediary burrows such as those of scolytids. Subsequent dissection of the length of the road-side log where the wasps were ovipositor-probing revealed several cerambycid larvae, mostly in the cambial layer and apparently too small for parasitism by the *Zaglyptogastra* females. A few larger cerambycid larvae deeper in the wood were also found but none of them had been parasitized or paralysed.

DISCUSSION

Although the new observations presented here do not provide any definite host records for the genus, they do indicate a number of potentially important points. Firstly, there is the possibility that *Zaglyptogastra* species attacking beetle hosts in larger pieces of dead wood may sometimes necessarily utilise the borings and exit holes made by other insects (such as scolytids) to gain access to the deeper burrows of suitable hosts because they cannot 'drill' through a solid wood substrate themselves. Secondly, that several females were observed, over a period of days, investigating pieces of substrate that upon dissection were found to be devoid of suitable hosts points to the use of unreliable host-searching cues, and it is tempting to speculate that these may in part involve

Fig. 2. Living *Zaglyptogastra* females. A, individual from forest site stinging senior author (white arrow indicates the strongly bent ovipositor apex with sharper lower valves penetrating skin; black arrow indicates the unbent antennae when not host searching); B-E female from road-side site: B, inserting ovipositor into beetle emergence hole, note apically strongly bent antennal tips (arrows); C, detail from B; D, E, host-searching females, lateral and front views.

volatiles from the borings of the smaller non-host beetle intermediaries. Scolytids and several other groups of 'ambrosia' beetles have obligate relationships with symbiotic fungi (Graham 1967). Thus, scolytid and similar infected wood is likely to give off a reliable odour cue for location of the fungal/scolytid system, and it is possible that other parasitoids that emerge in close association with such a substrate might learn this potentially useful cue and employ it during their initial host-searching activities. Since the *Zaglyptogastra* wasps reported upon here have no other real option for host location than to use holes made by small, non-host, beetles, then the use of, for example, scolytid-associated signals, might often lead to them investing a lot of time searching substrates in which there are no suitable large hosts.

The bending of the tips of the antenna by host-searching female *Zaglyptogastra* was completely unexpected as none of many hundreds of set individuals in museum collections examined by the senior author show any sign of this posture, and subsequent examination of antennae in preserved individuals suggests no special morphological features. Given the lack of internal flagellar musculature in pterygote insects (Chapman 1982, R. Romani pers comm.), the mechanism involved awaits discovery.

ACKNOWLEDGEMENTS

We would like to extend sincere thanks to the Tropical Biology Association, and in particular to Rosie Trevelyan, for their support during our visit to Kibale, Dr John Kasenene of Makerere University Biological Field Station for tree identification, the staff of MUBFS for all their help and hospitality, Dr Roberto Romani (University of Perugia) for information on insect antennal structure, and Dr Mark Shaw for many useful comments on an earlier draft of the MS.

LITERATURE CITED

Chapman, R. F. 1982. *The Insects. Structure and Function.* 3rd edition. Hodder & Stouton, London. 919pp.

Crowe, T. J. 1962. The biology and control of *Dirphya nigricornis* Oliver, a pest of coffee in Kenya (Coleoptera: Cerambycidae). *Journal of the Entomological Society of South Africa* 25: 304–312.

El-Heneidy, A. H. and D. L. J. Quicke. 1991. The Indo-Australian species of the braconine wasp genus *Zaglyptogastra* Ashmead. *Journal of Natural History* 25: 183–201.

Gauld, I. D. 1991. The Ichneumonidae of Costa Rica. 1. *Memoirs of the American Entomological Institute* 47: 1–589.

Graham, K. 1967. Fungus-insect mutualism in trees and timber. *Annual Review of Entomology* 12: 105–126.

Noyes, J. S. 1994. The reliability of published host-parasitoid records: A taxonomist's view. *Norwegian Journal of Agricultural Science Supplement* 16: 59–69.

Quicke, D. L. J. 1987. The Old World genera of braconine wasps (Hymenoptera: Braconidae). *Journal of Natural History* 21: 43–157.

Quicke, D. L. J. 1991a. The African species of *Zaglyptogastra* (Hymenoptera) with a checklist of world species. *Journal of Natural History* 25: 755–771.

Quicke, D. L. J. 1991b. Ovipositor mechanics of the braconine wasp genus *Zaglyptogastra* and the ichneumonid genus *Pristomerus*. *Journal of Natural History* 25: 971–977.

Quicke, D. L. J., M. G. Fitton, and J. Harris. 1995. Ovipositor steering mechanisms in braconid wasps. *Journal of Hymenoptera Research* 4: 110–120.

Shaw, M. R. 1994. Parasitoid host ranges. Pp. 111–144 in: Hawkins, B. A. and W. Sheehan, eds. *Parasitoid Community Ecology*. Oxford University Press, Oxford.

Shaw, M. R. 2003. Host ranges of *Aleiodes* species and an evolutionary hypothesis. Pp. 321–327 in: Melika, G. and C. Thuróczy, eds. *Parasitic Hymenoptera: Taxonomy and Biological Control*. Ministry of Agriculture and Regional Development of Hungary, Budapest.

Struhsaker, T. T. 1997. *Ecology of an African rain forest: logging in Kibale and the conflict between conservation and exploitation*. University of Florida Press, Gainesville, USA. 434pp.